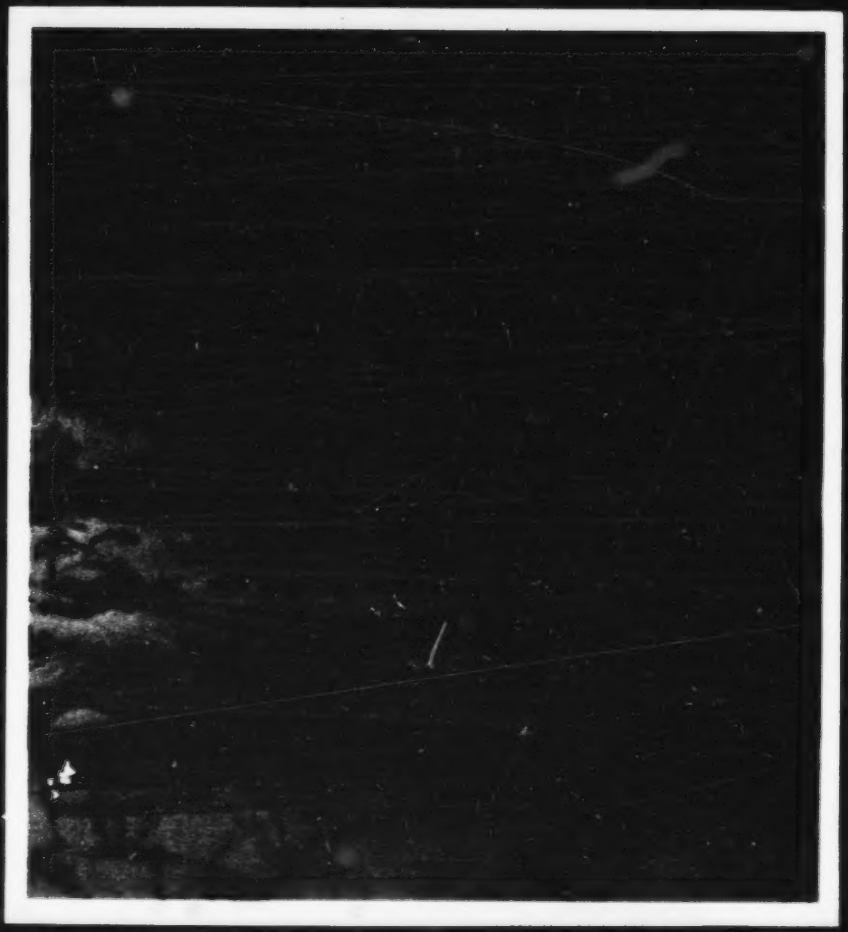
CHOICES IN SILVICULTURE FOR EASTERN CANADIAN FORESTS



FOREST EXTENSION BRANCH
NEW BRUNSWICK DEPARTMENT OF NATURAL RESOURCES

CHOICES IN SILVICULTURE FOR EASTERN CANADIAN FORESTS

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Foreword

This booklet is an adaptation of the first three chapters of "Choices in Silviculture for American Forests," published by the Society of American Foresters with cooperation of The Wildlife Society. Since the booklet is specifically intended for use in Eastern Canada, the original material has been edited to reflect eastern Canadian conditions. In line with this, the booklet refers to the two major forest types of this area; Northeastern spruce-fir and northern hardwoods.

The content has been purposely written in non-technical terms to help landowners understand how forest types can be managed for such benefits as recreation, watershed protection, wildlife and timber. Reprinting of the first three chapters has been undertaken by the Forest Extension Branch of the New Brunswick Department of Natural Resources. The Branch hopes that this booklet can help landowners manage their forests so that their many benefits are realized.

The original publication contains chapters dealing with nine major forest types in the United States. Copies of the original publication are available (in English only) from the Society of American Foresters. See inside back cover for details.

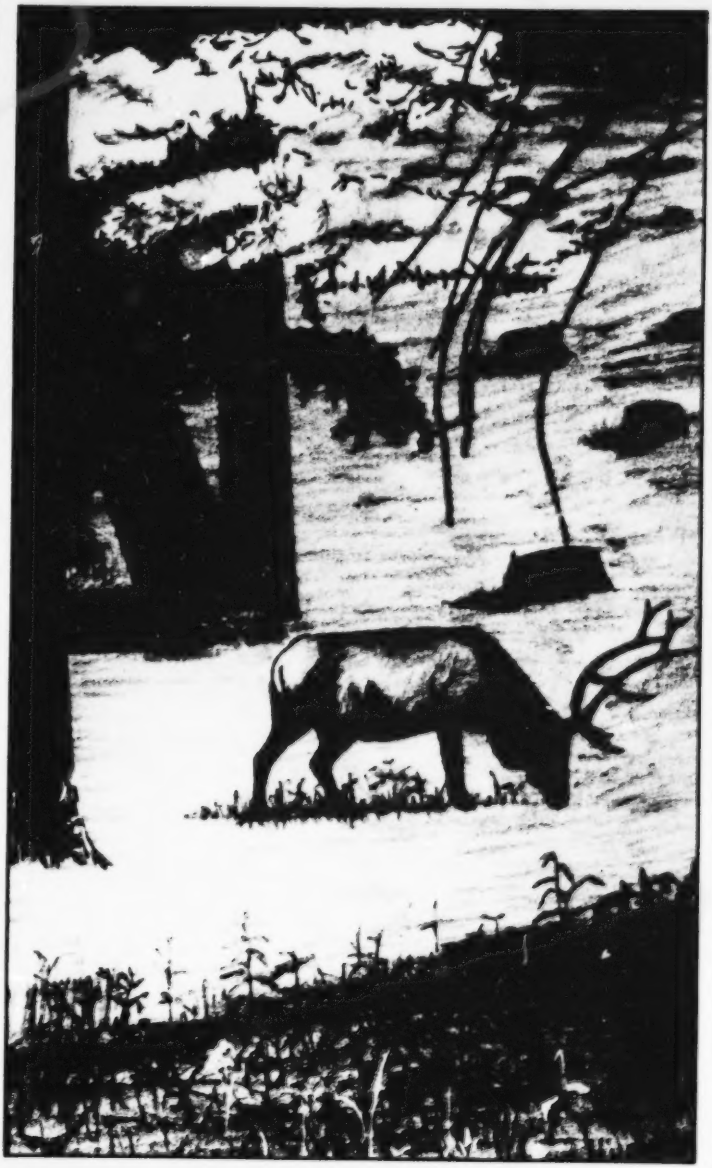
Contents

Original Chapter Authors — Page

FOREST TYPES AND TREATMENTS 1
David H. Van Lear, Clemson University

NORTHEASTERN SPRUCE-FIR 11
Barton M. Blum, USDA Forest Service
Harold M. Klaiber, Scott Paper Company
Arthur G. Randall, University of Maine (retired)

NORTHERN HARDWOODS 17
Ralph D. Nyland, State University of New York
David A. Marquis, USDA Forest Service
Donald K. Whittemore, International Paper Company



Forest Types and Treatments

North Americans are looking to their forests today for more benefits than ever before—recreation, watershed protection, wildlife, timber, wilderness. Foresters are often able to enhance production of these benefits. This booklet features forestry techniques that are helping to achieve the North American dream for the forest.

The story is for landowners, which means it is for everyone. Millions of North Americans own individual tracts of woodland, many have shares in companies that manage forests, and all own the public lands managed by government agencies.

The forestry profession exists to help all these landowners obtain the benefits they want from forests; but forests have limits. Like all living things, trees are restricted in what they can do and where they can exist. A tree that needs well-drained soil cannot thrive in a marsh. If seeds require bare soil for germination, no amount of urging will get a seedling established on a pile of leaves. The following pages describe the ways in which stands of trees can be grown under commonly occuring forest conditions in eastern and central Canada.

Originating, growing, and tending stands of trees is called silviculture (silva is the Latin word for forest). Without exaggeration, silviculture is the heartbeat of forestry. It is essential when humans wish to manage the forests—to accelerate the production of wildlife, timber, or to increase recreation and watershed values. Of course, some uses—wilderness, a prime example—require that trees be left alone to pursue their own destiny. And on almost any land, whether tree-covered or bare, nature will practice her own silviculture. She may take hundreds or thousands of years to do it, though, and she will do it without consulting humans as to their preferences. Whether they like to admit it or not, landowners often become impatient with nature's way. Then silviculture must be practiced; but in serving landowner purposes, foresters must still work within the natural conditions imposed by each tree species and its required environment.

The great number of tree species found in the United States and Canada—multiplied by all the possible growing conditions and all the stand histories—yields an infinite variety of forest scenes. Since it is not feasible to consider all possibilities at once, foresters think in terms of forest types. Evolutionary pressures, growth requirements, and stand histories cause certain tree species to occur together. In eastern Canada, for example, sugar maple, beech and yellow birch are often found growing together. Foresters call this association the tolerant hardwood forest type.

Naming types after dominant trees should not obscure the fact that a forest of any type is actually a community of hundreds of

plant and animal species. The entire community is strongly influenced by the species, size, age, and density of trees overhead. What happens to one individual in a community influences others. Competition for light, nutrients, water, food, and shelter is often intense. For example, if lightening kills a large tree in a dense forest, conditions are changed for many species. Woodpeckers find food and make nesting holes in the dead tree, young trees and shrubs thrive in the direct sunlight of the newly created opening, and ground-dwelling animals consume some of the new growth on these plants.

A stand of old trees may appear to be timeless, but all forests are constantly changing. Change is most obvious in young stands where the trees are growing rapidly. Such stands are ideal habitat for certain species of wildlife. As the trees grow larger, environmental conditions become so altered that some species of wildlife no longer thrive there, while other wildlife species may find the new conditions excellent. As the stand continues to age, still other wildlife species are favored in the continuously changing environment. These dynamic changes are natural in all forests. They cannot be prevented. They can only be accelerated or slowed by human activities.

This booklet covers the two most important forest types in central and eastern Canada. They are the spruce-fir type and the northern hardwood type.

Methods for establishing seedlings and culturing trees through maturity and harvest are described for each type. Depending on the type, the soil, and the landowner's objectives, foresters will prescribe treatments in various combinations called silvicultural systems.

Silvicultural Systems

The main—but not the only—treatments making up silvicultural systems, involve the cutting or felling of trees. Cuttings are commonly divided into those that help to reproduce forest stands (reproduction or harvest cuttings) and those that maintain vigor and desired composition and structure of the stands in terms of tree species, ages, and size classes (intermediate cuttings).

Reproduction cuttings have such a great influence on the character and management of the new stand—and the forest as a whole—that silvicultural systems are generally named after them. The major systems used in central and eastern Canada are **clearcutting, seed-tree, shelterwood, single-tree selection,** and **group selection.** Each system includes reproduction cuttings to establish seedlings and intermediate treatments to culture the developing stand.

The clearcutting, seed-tree, and shelterwood systems produce trees that are of approximately equal age, but may or may not be equal in size. These stands are called even-aged. The single-tree

and group selection systems produce and maintain stands containing trees of many ages, and thus are termed uneven-aged.

Brief descriptions of the five major silvicultural systems follow. Information on their applicability will be found in the chapters on the forest types.

Clearcutting is the harvesting, in one operation, of all trees in a stand or on an area, with the expectation that a new even-aged

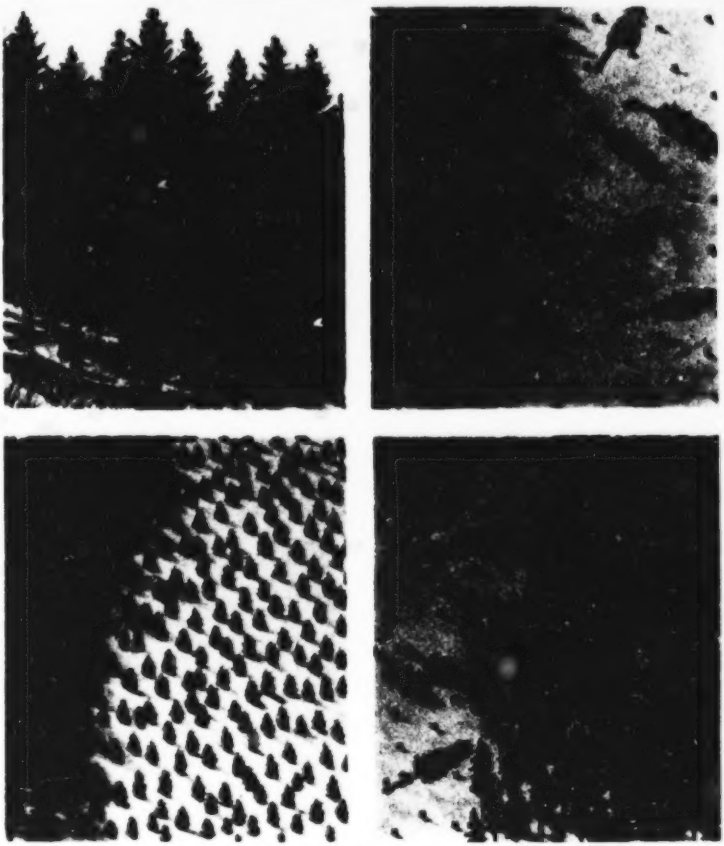


Figure 1. **Clearcutting.** *Part of a mature stand is cut, removing all trees. A new stand arises from seeds of surrounding trees or from sprouts sent up by roots or stumps. Seedlings may also be planted or seeds broadcast. When the new trees are well on their way in the unobstructed light of the clearing, a neighboring stand of mature trees is cut in turn. (The illustration is from* The Secret Life of the Forest *by Richard M. Ketchum, copyright 1970 by American Heritage Press, and is used with the permission of McGraw-Hill Book Company.)*

stand will become established *(figure 1)*. The new stand may develop by natural processes from seeds of adjacent stands, from seeds stored in the forest floor or still attached to branches in the tops of harvested trees, or from stump or root sprouts of cut trees. Another natural source of young trees is advance reproduction—young seedlings already established when the old trees are harvested. In many cases a clearcut area is regenerated by broadcast scattering of

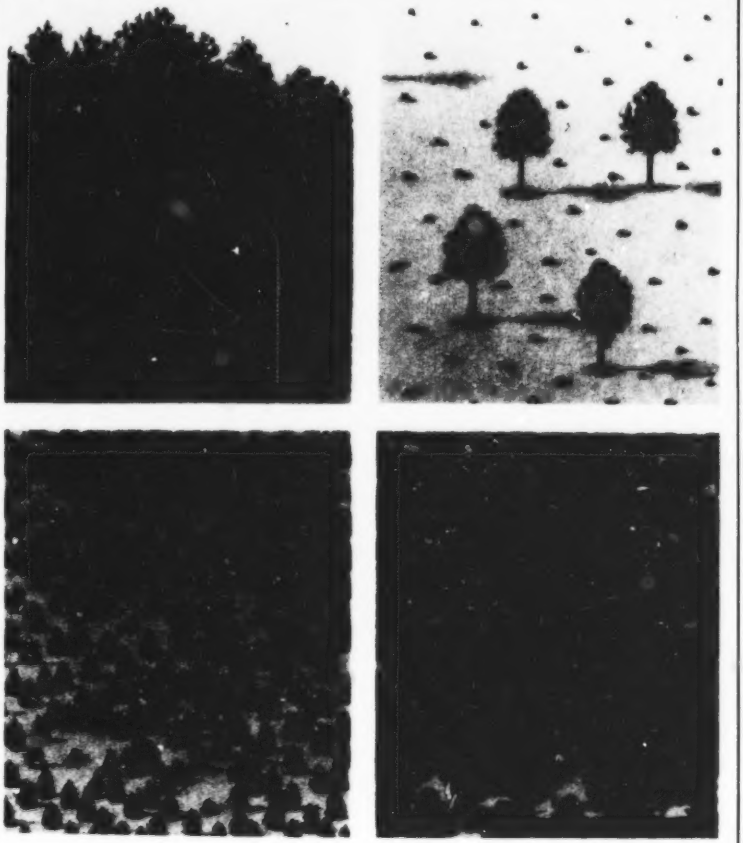


Figure 2. **Seed-tree System.** *The mature stand is logged, but enough trees are left to reseed the area. The seed trees usually are large and valuable, and may be harvested when they have fulfilled their purpose. Like clearcutting, the system favors light-demanding species. (The illustration is from* The Secret Life of the Forest *by Richard M. Ketchum, copyright 1970 by American Heritage Press, and is used with the permission of McGraw-Hill Book Company.)*

seeds or planting of seedlings. With clearcutting, as well as other reproduction cuttings, some type of site preparation is often necessary to remove logging debris and competing plants before the new stand can be established.

Many people believe that clearcutting destroys wildlife habitat. While this may be true for species requiring mature forest, stand removal actually creates habitat for wildlife species that satisfy part or all of their life requirements in low vegetation and brush with little or no overhead shade.

In a single stand, it is impossible to create ideal conditions for all wildlife species inhabitating a forest type. It is possible to do so in a sizable forest by providing a variety of stand conditions in different portions of the forest. Some areas can contain mature trees ready for harvest, others seedlings, and others middle-aged trees.

The **seed-tree system requires** leaving a few good seed-producing trees per hectare when the mature stand is logged *(figure 2)*. These trees provide the seed that is needed to regenerate a new even-aged stand. The seed trees are usually—not always—harvested after the crop of new young trees has become established.

The **shelterwood system** entails a series of partial cuttings over a period of years in the mature stand. Early cuttings improve the vigor and seed production of the remaining trees and prepare the site for new seedlings. The trees that are retained produce seed and also shelter for the young seedlings *(figure 3)*. Subsequent cuttings harvest the shelterwood trees and allow the regeneration to develop as an even-aged stand.

The **single-tree selection system** differs from the three just described in that it creates and maintains an uneven-aged stand. Foresters examine a stand and judge each tree on its merit. Individual trees are, in this way, harvested as they mature *(figure 4)*. Seedlings or sprouts grow up in the spaces thus created. Periodic harvesting and regeneration results in a stand that contains trees of many ages and of many sizes. Because relatively few trees are harvested at any one time, and because the forest floor is generally shaded this system favors species that can thrive in low light.

The **group selection system** requires harvest of small groups rather than individual trees. The openings created resemble miniature clearcuts, but with the major difference that the resulting regeneration occupies too small an area to be considered an even-aged stand. As in the single-tree system, thinning and harvest cuttings are done at the same time. The new trees that come up in these small openings are regarded as parts of a larger stand that contains trees of many ages. In either selection system, frequent harvests are needed to maintain a proper balance of tree age classes and sizes.

Intermediate Cuttings

To grow best, a tree needs a place in the sun and some soil of its own. If the stand is too dense, the forester may prescribe a **thinning** to relieve competition and to accelerate growth of the trees that remain. If the cut trees are too small to be sold, the thinning is called precommercial.

In a stand containing a mixture of desirable and undesirable trees, an **improvement cutting** may be made to favor the desirable ones. The choice of trees to remove will depend on the owner's

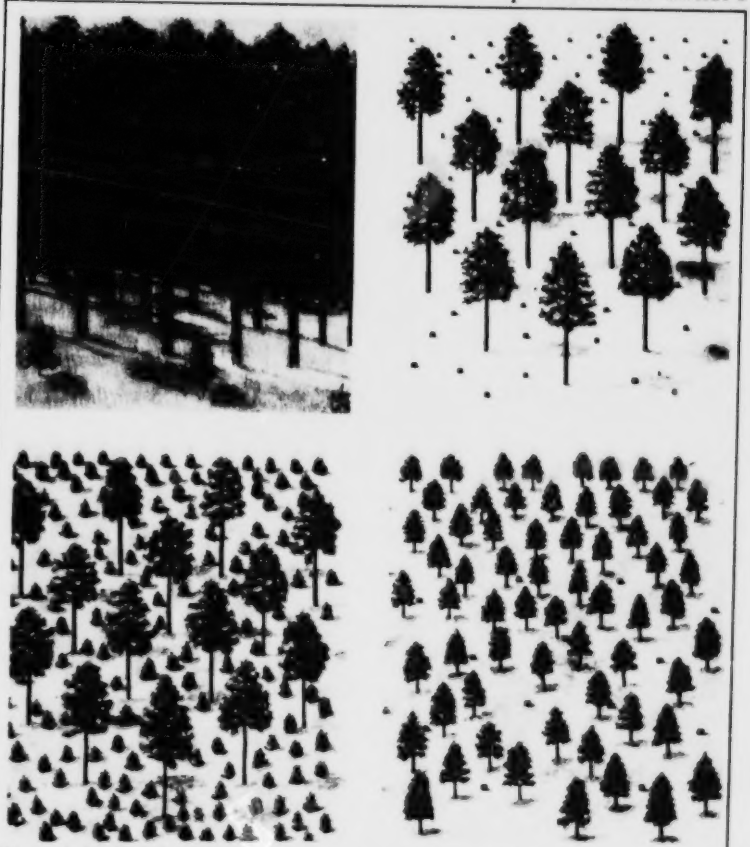


Figure 3. **Shelterwood System.** *A mature stand is partially cut, leaving some of the better trees of desired species to grow, cast seed, and provide shade and perhaps other shelter for the new stand. Usually more trees are left per acre than in the seed-tree system. These shelter trees will be harvested after seedlings have become established and no longer need protection.*

desire for timber, wildlife habitat, aesthetic appeal, or recreation. Many species of minor timber importance produce nuts and fruits of great value to wildlife.

Natural catastrophes such as windstorms, ice storms, and fires sometimes wreak havoc in forest stands. **Salvage cuttings** are prescribed to utilize damaged trees and reduce the economic loss. If some trees in a stand are damaged by insects or disease, the forester may recommend a **sanitation cut** to remove the infested or infected trees that pose a threat to neighboring healthy trees.

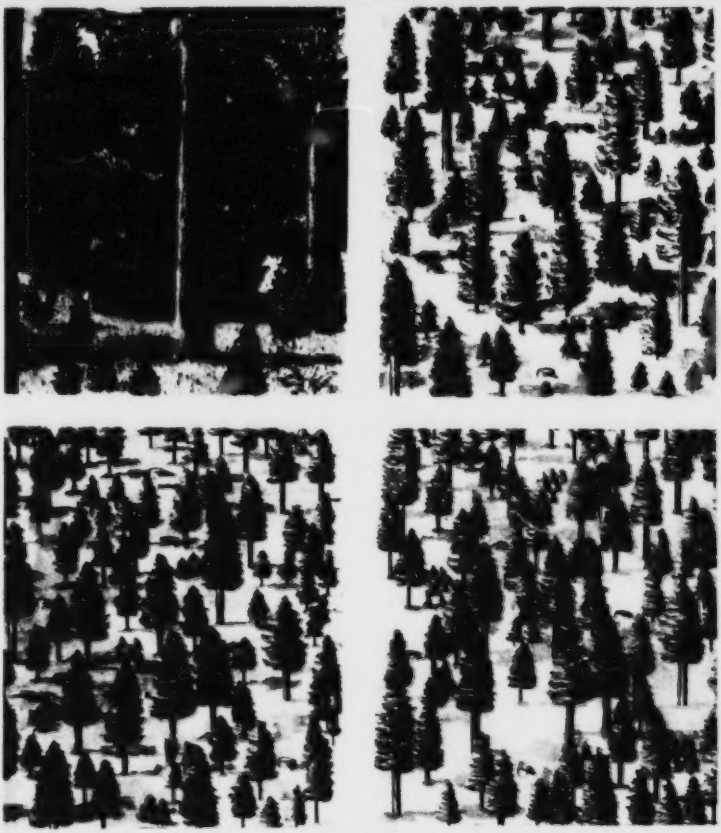


Figure 4. **Single-tree Selection System.** *Cuts are made more often than in other systems, but since the entire stand is never removed, appearances are not much affected. Undesirable trees are removed, overly dense areas are thinned, and mature trees are harvested during each cut. Seedlings of shade-tolerant species develop wherever they can find room. The stand contains trees of many ages.*

Intermediate cuttings can be distinguished from reproduction cuttings by their purpose. Reproduction cuttings create a new stand, while intermediate cuttings culture an existing stand. Most, though not all, intermediate cuttings are thinnings made to remove trees that crowd or restrict growth of better trees. In the single-tree and group selection systems, as noted, intermediate cuttings are generally accomplished simultaneously with reproduction cuttings. In the other three systems, intermediate cuts are made separately, and even though seedlings may become established in the openings, no attempt is made to nurture them to saleable size.

Choosing a Silvicultural System

The authors do not suggest any single silvicultural system as best for any single forest type. Rather they discuss benefits and limitations associated with the use of each system in each forest type. Their hope is that such information will help readers in all walks of life to understand—and to participate in—public forums on forestry. Perhaps the book will also be of value to students considering forestry careers. It is not intended to be a do-it-yourself book. The authors believe that choosing and applying a silvicultural system is a task for a professional forester, one familiar with local conditions and landowner objectives.

The benefits of a managed forest are influenced by the silvicultural system that is applied. Streamflow, quality of wildlife habitat, aesthetic appeal, and recreation potential, as well as timber production, may be affected. The choice of a system depends on the characteristics of the tree species that make up the forest type, the features of the site on which the trees are grown, and the objectives and resources of the owner. A forester can tell an owner what benefits are possible. Once the owner has defined his desires, a forester can apply a silvicultural system that provides the best mix of benefits.

The characteristics of the tree **species**[1] in the forest determine the range of alternative treatments a forester can prescribe. Chief among characteristics to be considered are species tolerance to shade, susceptibility to windthrow, adaptability to soil and moisture conditions, ability to withstand flooding, and vulnerability to insects, disease, and fire.

For example, a species needing full sunlight will not grow well under the shade of a tree canopy. A species with a shallow root system should not generally be regenerated by the seed-tree system because the seed trees might be blown down by wind before a new stand could become established.

When a forester talks about **site,** he includes all the physical,

[1] Names of tree species in this book follow the Checklist of United States Trees (Native and Naturalized) by E. L. Little, Jr. 1979. USDA Agriculture Handbook 541. Washington, D.C.

chemical, climatic, and biological features of an area that influence forest regeneration and growth. Site factors affect not only the growth of trees but also the sensitivity of the area to soil compaction, erosion, and stream sedimentation. In choosing and applying a silvicultural system, the forester must evaluate the erosion hazard, slope, drainage, and fertility of a site.

No matter which silvicultural system is chosen, **wildlife** will be affected. The effects may be for better or worse, slight or drastic, brief or enduring, depending on the forest type, the silvicultural system, the site, the conditions in adjacent stands, and other factors.

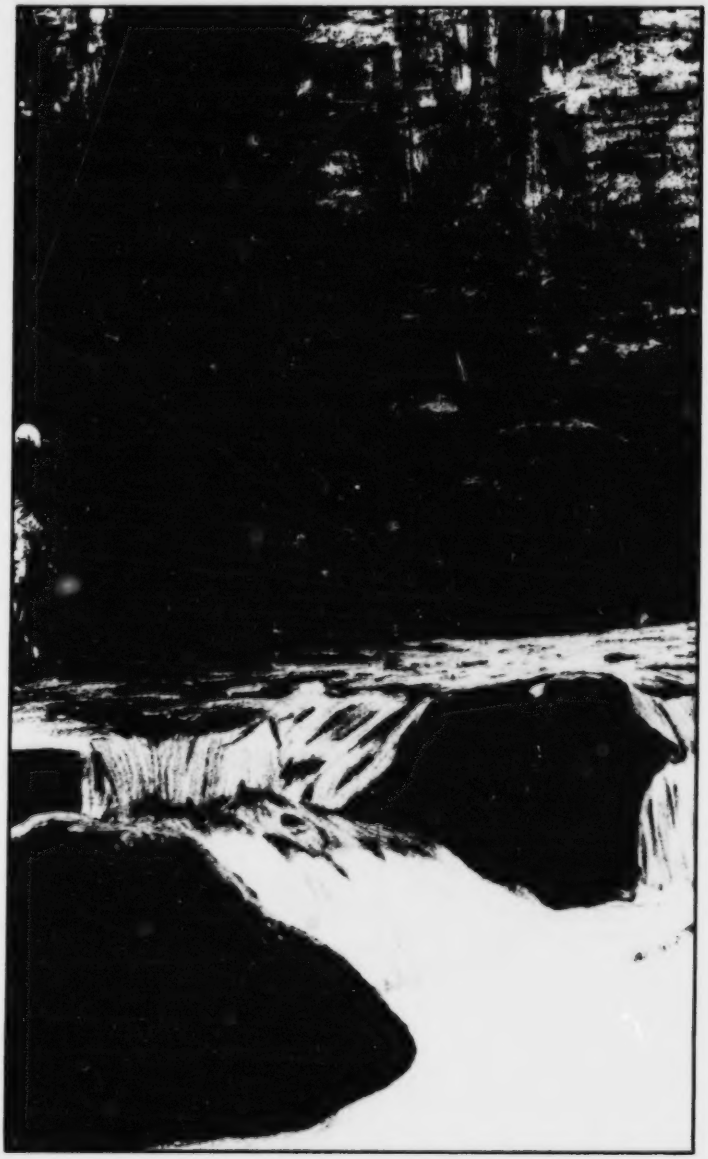
For example, single-tree selection maintains an almost complete canopy and usually has only small and brief effects on the wildlife species that thrive in a mature forest. Such cutting, however, does little for wildlife species that require open and brushy habitat. Clearcutting, by contrast, favors these species but eliminates the mature-forest habitats. To favor all wildlife, a forester must provide the different conditions required by individual species in different portions of the forest. Consultation with wildlife experts is often needed to determine habitat requirements.

The value of a stand as a wildlife habitat is influenced not only by tree species, but by their age, size, form, and health. Old trees have stout limbs on which heavy birds can nest. Bare branches provide roosts. Rotten spots can be hollowed into nests. Large dead trees (snags) are particularly important and should be left standing whenever possible. They provide habitat for hole-nesting and insect-eating wildlife.

A forester must always be guided by **owner objectives**. The desires and financial resources of clients vary widely. Small properties may be owned for many reasons including timber production, private hunting, and family recreation. Most owners of small properties desire a mixture of benefits. Public forests are usually managed for optimal production of multiple benefits, and procedures developed on public lands are often applicable on small private tracts. Most large private holdings are owned primarily for timber production.

It is the forester's job to inform the landowner-client of the choices in silviculture. Even where the primary desire is for one purpose, the owner may come to see advantages in the production of other benefits. It is often possible, for example, to improve conditions for wildlife with little sacrifice in timber growth.

Prescribing an appropriate silvicultural system is a complex professional decision—a decision based on many factors which may vary in degree and change with time. Choosing and applying a system for a forest stand, therefore, requires both knowledge and judgment. It is here that forestry becomes art—with biology and ecology providing the paints—landowners, the canvas—and foresters, the design.



NORTHEASTERN SPRUCE-FIR FOREST TYPE

Northeastern Spruce-Fir

Because of its wood yield as well as its water, recreation, and wildlife values, northeastern spruce-fir is one of the most important forest types in North America. Spruce-fir stands grow throughout most of eastern and central Canada. Here the stands occupy large areas, including banks of lakes and streams.

For people in major population centers, this type provides excellent settings for touring, outdoor recreation, fishing, and hunting. Spruce-fir forests protect watersheds of critical importance for generation of hydroelectric power and for industrial and domestic use. Fishing is excellent in relatively remote areas. Deer, bear, moose, and many fur-bearing animals thrive in managed spruce-fir forests. Very often, however, the primary source of income for a landowner is the sale of wood for paper, lumber and fuel. Harvesting of timber and manufacturing of wood products provides jobs as well as commodities. In managing spruce-fir forests, foresters must consider income for landowners, creation of jobs and products, but also preservation of natural beauty and other intangible values.

A stand is classed as spruce-fir if a majority of the trees in the overstory (the top canopy) are red, white, or black spruce, and balsam fir. Other conifers associated with these include northern white cedar, eastern hemlock, eastern white pine, and tamarack. Associated hardwoods often found are red maple, white birch, ash, American beech, sugar maple, yellow birch, and species of poplar.

Tree Characteristics

Northeastern spruce and balsam fir seedlings become established and survive many years under a dense tree canopy. As a result, stands are easy to reproduce by several silvicultural methods. Since good seed crops may be as much as 4 years apart for balsam fir and as much as 8 years apart for red spruce, foresters prefer to have seedlings established before the old stand is completely removed.

Insects and disease take a huge toll in this type, and a forester must always be aware of them when making silvicultural decisions. The most serious pest is the spruce budworm, which defoliates and eventually kills many trees during outbreaks. In spite of its name, it prefers balsam fir, and this species bears the brunt of each epidemic. The balsam woolly aphid is another insect that kills balsam fir, particularly in coastal areas.

Two important diseases of spruce are red ring rot and redbrown butt rot. Both are usually confined to old or damaged trees. Healthy, vigorous trees are resistant to infection by these rots.

Red heart and other diseases decay trunks of living balsam firs. These rots reduce the trees' value and make them susceptible to windthrow. Balsam fir so frequently contains rot that it is often managed on a "pathological" rotation. Harvesting is scheduled at ages of 50 to 60 years on poor sites and 70 to 90 years on better sites. Somewhat longer rotations would be advantageous in the absence of decay.

On deep, well-drained soils, spruce and fir may not become established as well as sugar maple, yellow birch, and beech. Furthermore, high-quality hardwoods such as maple and birch may have greater economic value than the spruce and fir. Foresters, therefore, give careful thought to where spruce and fir should be grown, often favoring them in hardwood mixtures on thin soils, on upper slopes, and on poorly drained soils, including swamps. On deeper, better drained soils, maple and birch are frequently preferred.

Red and white spruce and balsam fir have shallow root systems, particularly on the shallow and poorly drained soils where they thrive. As a result, they are highly susceptible to windthrow.

Silvicultural Systems

The ability of spruces and balsam fir to establish themselves under the shade of older trees offers a forester choices for reproducing stands. The only system that is completely unsuitable is seed-tree harvesting. Scattered trees left to seed an area are very likely to blow over before their mission is completed.

Clearcutting is an excellent method in overmature or weakened stands in which partial cutting exposes the remaining trees to blowdown. Clearcutting is also the system best adapted to mechanical harvesting.

It cannot be overemphasized, however, that a good new stand can only be expected if the seedlings are well established before harvest. In large clearcuts, high temperatures at the soil surface and excessive drying may kill very young trees. If heavy seedling loss is anticipated, harvesting can be done in narrow strips or small patches so that adjacent uncut areas provide partial shade to protect the seedlings. Another advantage of cutting small areas is that some seeding can be expected from adjacent stands. In a clearcut of any size, logging debris, heavy brush, and herbaceous plants may inhibit seedling growth.

Clearcutting of small areas creates excellent conditions for several species of wildlife. The herbaceous plants and brush that appear provide food and cover. The nearby mature timber adds the variety essential for the habitat of many wildlife species.

Where advance regeneration is absent or the old stand must be clearcut to check loss from rot or the spruce budworm, planting

may be necessary. Until recently there has been little planting of spruce or fir. With the advent of machine harvesting and an increase in the intensity of forest management, however, more clearcut acreage is being planted each year. Planting has the advantage of securing well-spaced trees of desirable species.

Considerable effort is required to prepare the site, and to reduce competition from unwanted vegetation. Before planting, logging debris and brush may have to be cleared. Several years after planting, seedlings often must be released from competing vegetation.

These operations strongly affect wildlife. Habitat quality for many wildlife species may be reduced if all vegetation that might compete with tree seedlings is eliminated. Wildlife generally benefits from the presence of a large number of plant species.

If a stand is approaching maturity and its understory does not contain sufficient seedlings to establish a new stand, the **shelterwood system** is often an excellent choice. One-third to one-half of the mature trees are removed to reduce the density of tree crowns and permit light to reach the forest floor. The best trees of the most desirable species are left so that their seeds will restock the area. The crowns of these trees provide shelter for seedlings. When the seedlings are well established the remaining mature trees are harvested.

This system usually works, but 5 to 15 years may be required for sufficient seedlings to appear. During this period, growth of the shelterwood trees is quite rapid, and it is concentrated on valuable trees. Thus, the long wait for regeneration need not be a disadvantage if the stand is less than fully mature when treatment begins. If the stand is mature or overmature, decay and windthrow can take a heavy toll.

The shelterwood system provides fairly good conditions for wildlife. Opening up of the stand in the initial cutting increases growth of browse plants in the understory, as does the final harvest.

Logging must be done with great care to minimize damage to shelterwood trees in the initial cut and to seedlings in the final harvest. It is best to make the final harvest while the young trees are still small and flexible.

Advantages of the shelterwood system are great reliability, good habitat for wildlife, and maintenance of a forest cover at all times. During and immediately after timber harvests, areas under the shelterwood system are somewhat more attractive in appearance than clearcut areas.

Disadvantages include the 5 to 15 years required for reproduction, the care required in logging, and the possibility of windthrow of shelterwood trees. On very shallow soils the risk of blowdown is increased.

The **single-tree** and **group-selection systems** are applicable in stands that contain trees of many ages and sizes. Because they can

tolerate shade, northeastern spruces and fir are well adapted to these systems. Repeated light cuttings favor the establishment of a sufficient number of seedlings and maintain a continuous tree cover that provides maximum soil protection along streams and rivers, and is desirable for touring and other recreation. Harvests at 5- to 20-year intervals permit salvage of trees that might otherwise die and be lost. Also, the number of fir trees may be reduced, rendering the stand less vulnerable to spruce budworms.

There are several disadvantages. Maintaining the desired mixture of tree ages and sizes requires considerable planning and skill. Harvesting is difficult because the area that must be covered to yield a given volume of wood is larger than in other systems and remaining trees must be avoided. Selection of the best trees for harvesting can constitute highgrading—depletion of the best growing stock. The harvesting machines presently available are not practical for selection harvests. Selection stands provide excellent habitat for woodland birds and winter cover for deer and moose, but they do not contain much browse for deer.

The openings created by cutting single trees may not be large enough to permit rapid growth of seedlings. Foresters, therefore, often remove small groups of trees. Group selection has many of the same advantages and disadvantages as individual tree selection, but the larger openings may reduce logging costs and improve wildlife habitat somewhat.

Intermediate Cuttings

When a spruce-fir stand is being managed for the first time, a number of its trees are likely to be rotten, low in vigor, or of unwanted species. Because decay is very rapid in fir, the first order of business is to remove trees that can be sold now and are not likely to live much longer. The second objective should be to get rid of otherwise undesirable trees with no sale value. The forest can then be fully occupied by desirable species. Since spruce is less susceptible to decay and insects, it is usually favored over fir.

These operations sometimes require an investment by the landowner, and careful planning is required to make the investment profitable. Sites supporting spruce and fir usually produce between 4 and 6 cubic metres of wood per hectare per year. The purpose of improvement cuttings is to increase the value of the stand by concentrating this growth on the best trees.

In the uneven-aged forests maintained by the selection systems, stand improvement, thinning, and cleaning (removal of unmerchantable trees) are done simultaneously with harvest cutting. In even-aged stands, these intermediate operations are separate from harvest cuttings.

Young even-aged stands of spruce and fir very often are so dense that without thinning they will take many years to reach merchantable size. Thinning while the trees are still small enough to be cut with one swing of a hand tool is often profitable. Thinning can also improve wildlife habitat, depending on the amount of material removed and the quality of the site. The first thinning to remove salable products should take place when the trees are 25 to 35 years old. Additional thinnings can be planned at 10- to 20-year intervals. Taking more than 40 percent of the timber volume in a commercial thinning is very likely to subject the remaining trees to windthrow. On shallow soils, considerably less than 40 percent should be removed.

REFERENCES

Baldwin, V. C. Jr., 1977. Regeneration following shelterwood cutting in a New Brunswick softwood stand. Canadian Forestry Service, Information Report M-X-76. Maritimes Forest Research Centre, Fredericton, New Brunswick.

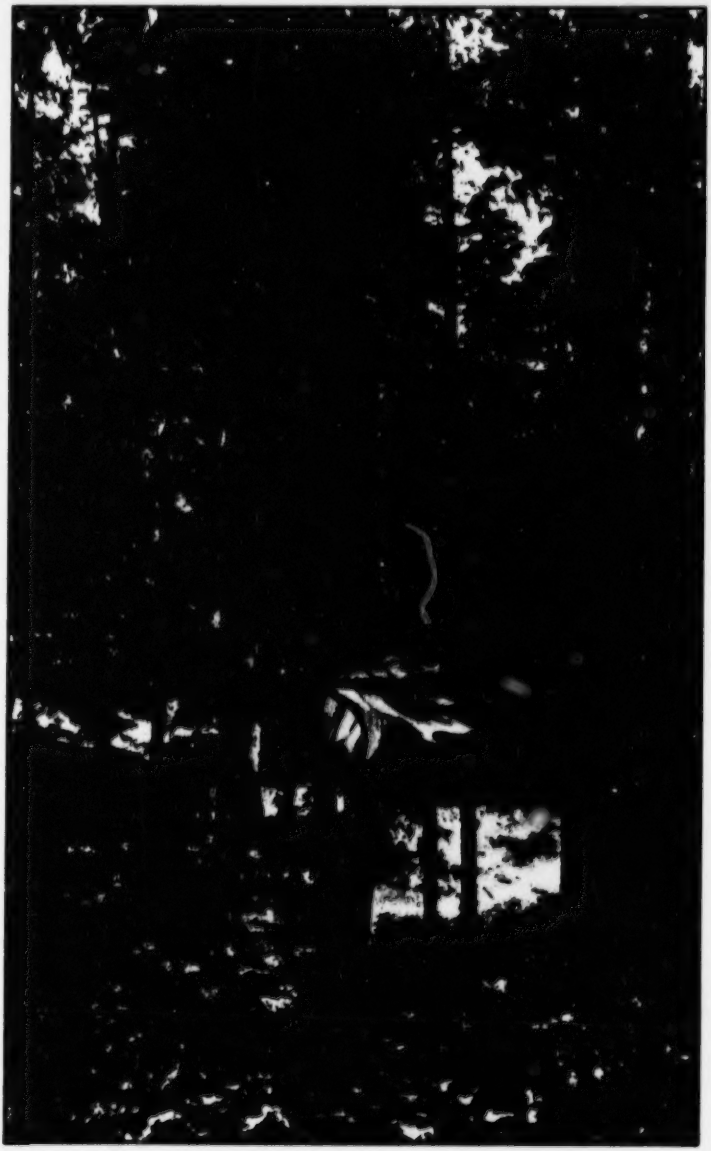
Banasiak, C. F. 1964. Deer in Maine. State of Maine Department of Inland Fisheries and Game, Game Division Bulletin 6, revised.

Fowells, H. A. 1965. Silvics of Forest Trees of the United States. USDA Agriculture Handbook 271. Washington, D.C.

Frank, R. M., and J. C. Bjorkbom. 1973. A silvicultural guide for spruce-fir in the Northeast. USDA Forest Service, General Technical Report NE-6. Northeastern Forest Experiment Station, Broomall, Pennsylvania.

Lull, H. W. 1968. A Forest Atlas of the Northwest. USDA Forest Service. Northeastern Forest Experiment Station, Broomall, Pennsylvania.

Titterington, R. W., H. S. Crawford, and B. N. Burgason. 1979. Songbird response to commercial clearcutting in Maine spruce-fir forests. Journal of Wildlife Management 43:602-609.



NORTHERN HARDWOODS FOREST TYPE

Northern Hardwoods

Our lives are sustained and enriched by the northern hardwood forests. In the fall, the diverse hardwoods, in brilliant color, form an unexcelled splendor across the hillsides. These same forests have supplied wood for fine furniture and architectural needs since colonial times. They still yield maple syrup and are once again being relied on heavily for firewood. They protect important watersheds and contain shrub and herbaceous plants used as food and cover by a myriad of animals and birds, large and small. The rolling and mountainous topography laced with streams and dotted with lakes and ponds attracts vacationers and sportsmen from nearby urban centers.

Tree Characteristics

The large number of useful tree species in the type provides remarkable flexibility in managing for various purposes. To qualify as northern hardwoods, a stand must contain abundant sugar maple. As a result, the distribution of this type closely follows the natural range of sugar maple. But many other trees occur in varying amounts depending upon location and past land use. These commonly include yellow birch, American beech, eastern hemlock, ashes, and red maple. Some stands also contain oak, elms, white and grey birch, white pine, red spruce, balsam fir, poplar, basswood and black cherry. Such tree diversity, coupled with a variety of shrubs and herbaceous plants, favors wildlife.

Sugar maple, beech, and hemlock form the climax species in the northern hardwoods. A climax species is one which, in the absence of disturbance, can occupy an area indefinitely, without being superseded by other species. The three climax species, plus red spruce, can survive as seedlings for many years under dense shade. If released by cutting or the natural death of a larger tree, the seedlings and saplings respond and grow well. Other species like black cherry, the ashes, and the birches also occur as seedlings beneath stands of older trees, but survive for only a few years under light shade and rarely persist under dense shade.

Northern hardwood species provide several possible sources of young trees to replace older ones that die or are harvested. Some seeds germinate each year under the shade of the large trees. If a harvest opens up the canopy, allowing sunlight to reach the ground, the seedlings will thrive. This advance regeneration may be supplemented by newly germinated seeds. Also, the stumps of many species, especially American basswood and red maple, sprout prolifically.

Beech may develop dense stands of sprouts from roots. These stump and root sprouts often supplement regeneration from seed.

Hardwood seedlings develop from seed that is stored in the leaf litter or that falls during a harvest of older trees. Various species react differently. New stands usually develop best when cutting releases seedlings already growing underneath the canopy of the older trees. However, the birches, black cherry, white ash, and red maple can also become established from seeds that germinate after cutting.

Fire or insects rarely prevent regeneration. Crowding by undesirable plants and unfavorable weather may cause failure. If intense and prolonged, feeding by white-tailed deer or domestic cattle may prevent satisfactory regeneration, and even influence species composition as deer prefer sugar maple, birches, ashes, and black cherry. Under most circumstances, however, northern hardwoods can be regenerated, even while providing ample browse for deer.

Many insects feed on large northern hardwood trees, but they seldom cause large-scale losses. Fire usually does not prove significant. Fungi enter trees through wounds, and can discolor and decay wood sufficiently to make logs unsuitable for lumber and other high-value products. To prevent wounds and subsequent decay, great care must be taken to avoid tree injury during harvests.

Silvicultural Systems

Several silvicultural systems are appropriate for this type. As in other forest types, the proper system depends upon objectives of the landowner. Each system has characteristics that may help satisfy special needs for recreation, wildlife, water, timber, or combinations of these. Generally, the great diversity of species and conditions allows flexibility in managing to satisfy landowner interests.

Where timber is a primary objective, a silvicultural system will usually favor species that have high value in local markets or serve special needs of the owner. Cuttings also help to enhance and maintain habitat for wildlife that owners enjoy seeing, hearing, or hunting.

In some northern hardwood stands, the trees are all about the same age. Other stands contain trees of many ages. With the even-aged stands, owners can use clearcutting or shelterwood methods to regenerate a new tree crop when the old one reaches maturity. These methods generally favor species that grow well only in light that is full or nearly so. When the trees reach intermediate ages, the owner will thin the stand to encourage rapid growth of the best trees. Uneven-aged silviculture differs. Mature trees are cut out singly or in small groups to regenerate a new age class of trees. Additionally, parts of the stand containing immature trees are thinned to reduce crowding. This approach generally favors sugar

maple, beech, hemlock, and red spruce, which can develop and grow under shading of older trees. Both even- and uneven-aged silviculture can be used.

Even-aged Systems

Clearcutting provides one way to regenerate new stands all having about the same age. The entire mature stand is felled and replaced by a new one of young seedlings. As these new trees grow, the owner will thin the stand, nurturing it to maturity, then once more clearcut to regenerate another crop.

In northern hardwoods not heavily browsed by deer or cattle, many seedlings and saplings grow under the shade of mature trees. They often include a variety of species and provide a primary source of regeneration for the new stand following clearcutting. Additional seedlings usually become established after clearcutting, too, so that regeneration includes both trees that developed in advance of the cutting and ones from seeds that germinated later. This combination provides for a mix of species, including ones that will not survive under the shade of older trees. Birches and red maple can develop quickly from seeds dispersed into newly created forest openings, especially if seeds fall onto mineral soil or decayed organic material. Clearcutting normally will increase the abundance of white and yellow birch, red maple, black cherry, white ash, white pine, and poplar. All of these need light and grow poorly under shading.

Stump sprouts grow rapidly in clearcuts. If the stumps are low, the sprouts develop into satisfactory trees. Because sprouting capacity decreases as trees age, sprouts seldom dominate regeneration following clearcutting of stands more than 75 years old.

Clearcuts can be designed in various shapes and sizes. By using different combinations, the forest manager is able to satisfy many objectives. Narrow strips, small circular and rectangular patches, and larger blocks have all proven satisfactory. Where deer browsing may be heavy, clearcutting should be confined to stands having abundant advance regeneration. Also, the clearcut should cover an area large enough to regenerate more young trees than the local deer herd can eat. Elsewhere, appearance, wildlife habitat, and logging requirements may determine the size of clearcuts.

Clearcutting provides excellent habitat for birds and animals during the first 10 to 15 years of stand development. The seedlings and saplings that flourish in profusion after clearcutting provide abundant browse. Thus, a regular program of clearcutting parts of a large forest area will create stands of many ages and benefit bird and animal species. Clearcutting also increases water yields for about 5 to 7 years. On the other hand, this system causes an important change in the appearance of an area and may look unattractive for

a few years until a new stand arises. Consequently, clearcutting will not usually satisfy interests of landowners who want to keep their forests looking undisturbed.

The **seed-tree system** has no value in the northern hardwoods. The new stand generally originates from seedlings and saplings that were established prior to harvest. In addition, most species in this type produce abundant seed that will store in the leaf litter for 3 to 10 years. Thus, seed trees are unnecessary.

The **shelterwood system** regenerates stands of trees all having about the same age. It establishes a crop of new seedlings and allows them to get a good start before all the older trees are removed. The shelterwood system requires at least two cuttings on the same area. First, harvest of some of the older trees allows sunlight to reach the ground. This added light stimulates growth of seedlings after germination. Then a second cutting removes the remaining older trees.

Even a first cut that removes only 30 to 40 percent of the old stand will allow new seedlings to germinate and grow. Still heavier cuttings, removing at least half the older trees, favor establishment of species that grow best in full sunlight, such as the birches and poplar. Fairly heavy thinning (as distinguished from a harvest cut) in trees approaching maturity encourages seedlings to develop and serves the same purpose as a shelterwood cutting. In all cases, once adequate numbers and sizes of new seedlings and saplings form on the area, the remaining overstory can be removed to create an opening similar to a clearcutting.

When forest managers grow the new regeneration to large sizes—say 10 feet or more in height—before removing the older trees, they can avoid most of the unattractive appearance associated with clearcutting. Such stands never lack trees of at least sapling size. Shelterwood cutting also has value where the species composition or density of regeneration would not prove satisfactory after a clearcutting. Benefits for wildlife and watershed management are similar to those from clearcuttings.

Intermediate Cuttings

As even-aged stands develop, the trees become crowded and their growth slows. Then the forest manager begins a series of thinnings to nurture the new crop to maturity. Research and field trials with northern hardwoods have shown little gain from thinning stands less than 30 to 35 years old, but after that age the trees will benefit.

Landowners often delay first thinnings until trees that are cut have value for pulpwood or other timber products. Usually northern hardwood stands do not yield commercial volumes of salable products until 45 to 50 years of age. From that time until the final

harvest, thinnings will provide income to the landowner while improving growth and quality of the remaining trees.

Thinning should remove trees of the poorest quality and vigor, and should release ones with the greatest potential to grow rapidly into high-value trees. Some fairly good trees will also require cutting to provide ample growing space for those of greatest potential. The cut depends upon purposes of the owner and the time that will elapse before the next thinning.

Thinning may stimulate growth of understory plants needed by many wildlife species. These usually disappear after a few years when the crowns of remaining trees spread enough to shade the ground, unless repeated thinning opens the canopy again. Normally, thinnings in northern hardwoods have little influence on water yields, or on the general appearance of the forest.

Uneven-aged Systems

Stands managed by the **single-tree selection system** are cut more or less regularly—perhaps at intervals of 10 to 30 years—to remove part of the crop. At each harvest, mature trees are removed to make space for new seedlings to develop. Also, younger trees are thinned. These cuttings remove single trees from across the stand, leaving behind well-distributed immature ones. The combination of new, young, and older trees makes the stand uneven-aged.

Single-tree selection works in northern hardwoods because sugar maple, beech, hemlock, and red spruce can grow under partial shade and develop in the small openings created by harvesting of a single mature tree. Seedlings of black cherry, poplar, white ash, yellow birch, basswood, red oak, and white pine will not normally survive in such shade. Their numbers will decrease with each subsequent harvest, unless the stands are cut heavily.

Though the damage can be held down by care in logging, felling of scattered individual trees and skidding them out of the stand, inevitably causes injury to some uncut trees. Wounds caused by these injuries allow the entrance of fungi that discolor and decay wood, lessening the value of the tree for timber products.

Single-tree selection can prove useful for owners of small properties who want regular income from timber and little change in the appearance of their woodland. Cuttings do improve habitat for wildlife, but benefits last only until tree crowns grow together to fill spaces within the canopy. The selection system provides excellent watershed protection, but will not importantly improve water yields.

In the **group selection system,** cuttings remove groups of two or more trees, rather than single trees. By comparison with single-tree selection, such cuttings create larger openings in the forest where sunlight can reach the ground. Species that cannot survive and grow well under partial shading can develop in these openings.

Thus, regeneration often includes more birch, black cherry, white ash, and poplar seedlings than are found under single-tree selection. By combining group removals and thinning of immature trees, the cuttings maintain a proper arrangement of tree sizes and ages to provide for regular harvests.

For water yields, wildlife management, and visual characteristics, group selection produces the same benefits as single-tree selection.

REFERENCES

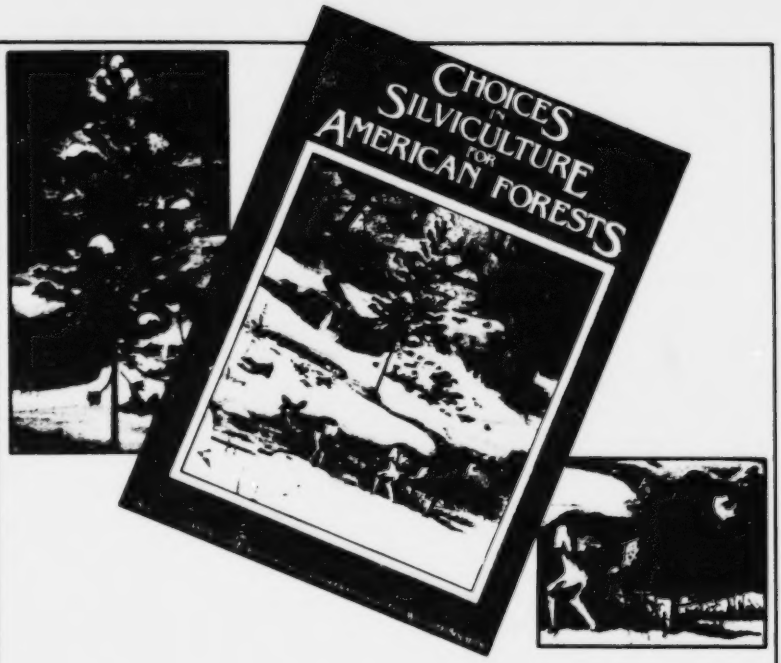
Leak, W. B., D. S. Solomon, and S. M. Filip. 1969. A silvicultural guide for northern hardwoods in the Northeast. USDA Forest Service, Research Paper NE-143. Northeastern Forest Experiment Station, Broomall, Pennsylvania.

Lees, J. C., 1978. Hardwood silviculture and management: An interpretive literature review for the Canadian Maritime Provinces. Canadian Forestry Service, Information Report M-X-93. Maritimes Forest Research Centre, Fredericton, New Brunswick.

Marquis, D. A., T. J. Grisez, J. C. Bjorkbom, and B. A. Roach. 1975. Interim guide to regeneration of Allegheny hardwoods. USDA Forest Service, General Technical Report NE-19. Northeastern Forest Experiment Station, Broomall, Pennsylvania.

Nyland, R. D., P. J. Craul, D. F. Behrend, H. E. Echelberger, W. J. Gabriel, R. L. Nissen, Jr., R. Uebler, and J. Zarnetske. 1976. Logging and its effects in northern hardwoods. State University of New York, College of Environmental Science and Forestry. Research Report 31. Applied Forestry Research Institute.

Roach, B. A. 1977. A stocking guide for Allegheny hardwoods and its use in controlling intermediate cuttings. USDA Forest Service, Research Paper NE-373. Northeastern Forest Experiment Station, Broomall, Pennsylvania.



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